The Winner's Curse of Human Capital†

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Abstract

We extend a model developed by Evans and Jovanovic (1989) to explain when start-ups are credit constrained. We show that the magnitude of the credit constraint is conditioned by the relative productivity of human capital in both wage work and self employment. Empirical analysis reveals that entrepreneurs with greater levels of human capital and entrepreneurial abilities have both greater financial wealth and greater levels of start-up capital pointing to the endogenous nature of credit constraints. Start-ups are generally financially constrained when measured by the impact on start-up capital of predicted household income. Greater levels of human capital relaxes financial constraints, apparently due to greater productivity of human capital in wage work than in self-employment. Paradoxically, then, those who are the least likely to be credit constrained in self-employment are those that are least likely to switch into self-employment, and vice versa.

1. INTRODUCTION

One of the more important trends occuring in the Canadian labor economy is the rise in self-employment, from 16.3% of men aged 25-64 in 1983 to over 18% of men aged 25-64 in 1994 (Schuetze, 1998). Of particular interest has been to investigate the popular claim that there is a lack of capital to fund these ventures. Since new small firms represent a large fraction of recent job creaters in Canada (Picot and Dupuy, 1996), suboptimal capital levels in new firms due to credit constraints may have a large impact on the Canadian economy. But it has not yet been fully established how large the problem is, if it exists.

Following the theoretical papers by Jaffee and Russel (1976), Stiglitz and Weiss (1981), and Evans and Jovanovic (1989), a growing amount of empirical literature has investigated whether new businesses are capital constrained. Previous research has covered three relevant areas. One line of work has looked at the implications of financial constraints for the choice between paid work and self employment [Bernhardt 1994, Blanchflower and Oswald 1990, Evans and Jovanovic 1989, Evans and Leighton 1989, Holtz-Eakin, Joulfaian and Rosen, 1994a (from hereon HJRa), Xu 1998]. A second line of research has been concerned with the determinants of the supply of capital to start-up firms (Bates 1990, Grown & Bates 1991, Evans and Jovanovic 1989). Researchers have also studied the rate of survival of small start-up firms conditioned on access to capital (Bates 1990, Cressy 1996, Grown and Bates 1991, Holtz-Eakin, Joulfaian and Rosen 1994b: hereafter HJRb).

This paper is concerned with the effects of human capital and financial wealth on the level of capital in a start-up. As modeled by Evans and Jovanovic (1989), (hereafter 'EJ'), there is a

cap on the level of capital used in the start-up because lenders are assumed to lend only up to a fixed amount of the entrepreneur's wealth thus constraining those having a greater optimal capital level. A positive correlation between the level of capital in the firm or the survival of the firm and the entrepreneur's wealth is therefore said to indicate credit constraints. Such correlations have been found by HJRa and HJRb. But if there is a correlation between human capital and wealth and between human capital and self-employment earnings the policy implications from observing an association between wealth and capital (or business survival) are unclear. Indeed, recent analyses by Cressy (1996) suggest that there is no correlation between wealth and business survival once human capital is controlled for.

In Section 2 we extend EJ's model in two ways: 1. We relate wage earnings to wealth. 2. We relate human capital to self-employment earnings. Greater human capital then increases the optimal capital level in the start-up thereby increasing the credit constraint for a fixed level of wealth, but also diminishes the credit constraint because of its positive effect on wealth. Contrary to the claim by EJ that human capital is uncorrelated with credit constraints, and the implicit assumption by Cressy that it increases the constraint we find the effect to be theoretically undetermined. In Section 3 we present data and in Section 4 we estimate reduced form models of start-up capital as a function of human capital, financial wealth and entrepreneurial abilities, when the owners are predominantly white males. Section 5 summarizes.

2. THE MODEL

Initially, we follow Xu's (1998), extension of EJ. This is a two-period model where wealth is endogenously determined. Individuals differ in their entrepreneurial ability (q) which

they know. We assume zero wealth endowments so that all are wage workers in period 1. Each individual receives a wage income (w) at the end of period 1, which is divided into consumption (c), and savings (z) where

$$z=c^*w, \quad (1)$$

and optimal consumption, c^*, is a proportion of income in period 1. Simplifying EJ's notation slightly, the wage equation is

$$w=\mu x^{\gamma} \quad (2)$$

where x denotes human capital, and $0<\gamma<1$, $\mu>0$. Entrepreneurial choice occurs in period 2. The period-2 income for a wage worker is $w+rz$, where r is the (gross) interest rate. The period-2 net income for an entrepreneur is

$$\pi=y+r(z-k), \quad (3)$$

where y denotes earnings and k is the amount invested in the business. We now depart from Xu and EJ, and assume that earnings in entrepreneurship also depend on human capital:

$$y=\theta x^{\delta}k^{\alpha}, \quad (4)$$

where $0<\alpha<1$ and $0<\delta<1$.[1] Following EJ, we assume that an individual can borrow no more than $(\lambda-1)z$ where $\lambda>1$ measures the tightness of the financial constraint.

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[1] As in EJ, this model assumes that human capital and entrepreneurial abilities are uncorrelated. Theoretically modeling them as correlated is analytically intractable (see also comment by EJ, footnote 8.) A positive correlation might result in less of a credit constraint. Entrepreneurs would tend to be high-wage people who are more likely to have accumulated sufficient start-up funds. But entrepreneurs would also have higher optimal capital requirements with an increase in the correlation coefficient suggesting greater credit constraint for fixed wealth. The net effect on the credit constraint depends on the magnitude of the correlation, the relative productivity of human capital in wage work and self-employment, and the productivity of capital in self-employment. Our empirical estimation accommodates any potential correlation between the coefficients for x and θ and we find a slight positive association.

An entrepreneur's desired investment is solved by maximizing

$$\pi = \theta x^{\delta} k^{\alpha} + r(z-k). \quad (5)$$

The solution is

$$k^* = (\theta x^{\delta} \alpha / r)^{1/(1-\alpha)}, \quad (6)$$

indicating that the optimal capital is a positive function of x and θ. An entrepreneur is financially constrained if $k^* > \lambda z$. For $k^* > \lambda z$ we get

$$\lambda z < (\theta x^{\delta} \alpha / r)^{1/(1-\alpha)}. \quad (7)$$

For an entrepreneur *not* to be credit constrained the following inequality needs to hold:

$$\theta_{max} \leq (r/\alpha)[\lambda c^* m)]^{(1-\alpha)} x^{(1-\alpha)\gamma-\delta}. \quad (8)$$

The sign of $\frac{\partial \theta_{max}}{\partial x}$ depends on the sign of the exponent for x. If human capital productivity is significantly higher in wage work than in self-employment and capital productivity is modest then, paradoxically, the credit constraint diminishes. The intuition is that while x increases capital needs for a given θ, x also increases wealth and the latter effect is stronger for those with high wage productivity thus reducing the credit constraint.[2]

3. DATA

3.1 The Data Base

We used the 1987 U. S. Census Characteristics of Business Owners (CBO) data base to analyze the effects of human capital, entrepreneurial ability and financial wealth on the level of

[2] Appendix 2 illustrates how human capital affects the selection between self-employment and wage work.

capital in start-ups. The data base is described in Nucci (1992).[3] The sample was taken from the set of 1987 tax filings for various forms of small businesses: single ownerships, partnerships, and small (sub-chapter S) corporations (U. S. Bureau of the Census, 1991, iv). The 1987 CBO survey contains information on businesses that were in operation in 1987. In addition, we use the 1982 CBO, and the 1987 County Business Patterns datasets to create three industry-level control variables. We also use the 1990 Census of Population to merge in exogenous predictors of household income.

3.2 Sampling

Three concerns guided our decisions on sampling: 1. We sought to avoid complicating factors that would make interpretation of our results more difficult. To this end we used the white male sub-sample, while excluding minorities and white females. The white male sub-sample contained 26,620 owner observations. 2. We were concerned about sample attrition. The sample consisted of firms which were started in 1987 or earlier. Those started earlier had been subject to uncontrollable, and potentially biased attrition. We thus limited the sample of businesses to those that were started in 1987. These businesses were start-ups in the sense that owners were new to the businesses in 1987. 3. We eliminate companies that had zero capital at start-up, because, according to EJ, these would never be started. After these selections, 986

[3] The U. S. Census has conducted the survey "Characteristics of Business Owners" (CBO) every fifth year, with data currently available for 1982, 1987 and 1992. The CBO is available on-site at the Census Research Data Centers (currently Washington D.C., Boston and Pittsburgh) to interested researchers. Wolken (1998) provides some detail on various sources of survey data on small business finance, including the CBO.

firms formed in 1987 with greater than zero start-up capital remain. These firms are represented by 1194 usable individual owner questionnaire responses.

3.3 Data and Measures

The variables that we use appear in Table 1. The first column in Table 1 lists the names of the variables that we use. The second column contains a description of measurements of the variables.[4] Human capital data are provided at the individual level but start-up capital is at the firm level. For most measures of human capital we summarize human capital inputs with the proportions of all responding owners in the firm obtaining a specific level of the human capital measure. (If there is only one owner this reduces to either zero or 100%.) To control for the total amount of human capital input we measure how many owners there were in the firm. We measure human capital with the following variables: age, education, type of college degree (conditional on having a bachelor's degree), years of work experience, managerial/executive work experience, and number of owners.

We measure entrepreneurial abilities with three variables: if the owner has worked in a business owned by family members (parents, spouse, siblings, or other relatives in close contact), if the owner has owned a prior business and whether the family has previously owned a business. Whether the family has previously owned a business may reflect entrepreneurial experiences through vicarious learning.

We measure financial wealth with predicted household income. Rather than trying to capitalize income into a stock of financial wealth (which would require some heroic

assumptions), we regressed the log of household income on measures of human capital, entrepreneurial abilities, age, interactions with age, whether the individual has ever been married, a set of geographic dummies, and county-level population data from the 1990 Census of Population.[5]

In Table 1 we report some descriptive statistics, weighted for sampling design and non-response pattern, for firms started in 1987. The mean household income less start-up income is $25,540 (st. dev.=$29,598), and is less than $10,000 for 38% of the sample. Seventy-two percent have household incomes (less start-up income) below $25,000.[6] The sample mean is about equal to the U.S. mean household income, but the distribution is more skewed.[7] The mean firm capital at start-up is $32,140 (st. dev.=$77,700) (note that we exclude those with zero capital.) Sixty-six percent of the firms with capital are started with less than $10,000.[8]

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[4] Like most surveys, the CBO suffers from two types of non-response bias: unit and item non-response. Appendix 3 describes how we dealt with issues related to non-responses.

[5] We used a dummy for each of the census regions. We also interacted a dummy for the State of California with the dummy for the Pacific region to separate residence in California from residence in the states of Oregon and Washington. We used a dummy for whether the individual resided within a Metropolitan Statistical Area. For each county we used the 1990 Census of Population to measure the percentage of whites, the percentage between 25 and 64 years of age, the percentage over 64, median family income, the percentage of owner occupied housing, the percentage of owner occupied housing with more than five bedrooms and the median value of owner occupied housing units. Observations from Alaska and Hawaii were excluded because those states do not report county-level data.

[6] The mean household income including start-up revenue was $37,789 (st. dev.=$35,762).

[7] The mean 1992 household income for all tax filers was $31,945 in 1992 (ftp://ftp.fedworld.gov/pub/irs-soi/92in14ar.exe), 26% had household income less than $10,000 and 56% had less than $25,000. Therefore, we can conclude that our sample mean is about equal to the U.S. mean household income, but that the distribution is more skewed in our sample, with a higher proportion having less than average income compared to all U.S. households.

[8] In comparison, HJRb, impute depreciable assets from depreciation deductions for those who had started a firm between 1981 and 1985. The average capital in their sample, conditional on having positive assets, was less than half of ours, $14,930 (st. dev.=$60,185). One explanation for the difference is that we select white males, which tend to start businesses at higher levels of capital than both females and blacks. In HJRb the distribution of start-ups by race and gender is unknown, and pooling these groups is likely to produce lower means, and might also bias coefficient estimates. Second, HJRb measures only depreciable assets which likely causes a downward bias. We found the mean start-up capital to be $24,410 for white female-owned start-ups. Grown and Bates (1991), found that blacks started construction companies at

We created three industry-level measures to control for the shape of the production function: one for capital and two for labor scale economies. The first was constructed from the 1982 CBO data set. We measured capital scale economies by median firm assets for start-ups that survived the period 1982-1986, per each 2-digit SIC industry. Since this estimate applies to start-ups it is likely to be much smaller than other estimates of scale economies. Industry median assets varies between $2,500 and $37,500. A dummy, ASSET82H, was created that takes the value one if industry median firm assets are greater than the 3rd quartile value of the small surviving 1982 start-ups ($7,500), else zero. We proxied labor scale economies with the percentage of plants in the industry with either 1-19 employees or with 1-49 employees. The two latter variables were based on data from County Business Patterns, 1987.

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insert table 1 around here

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4. RESULTS

We regressed the log of household income on measures of human capital and entrepreneurial abilities at the individual level plus the geography dummies and county-level measures from the 1990 Census of Population. Results are reported in Table 2.[9] Using first-

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less than 40% of the capital of whites, and that regression coefficients for obtaining debt capital were significantly different for the two groups.

[9] Data on household income are reported on an interval scale. An ordinal probit model was initially used to accommodate these data. Since there are ten intervals, data becomes too sparse per cell to estimate interaction effect. These regressions are not reported because of concerns that it would violate Census

order effects of human capital we obtain an R^2 of 0.13 (Column 1). Age and work experience are highly collinear in this model. Adding three measures of entrepreneurial ability increases R^2 to 0.15 (Column 2). Whether the individual had worked in family business is highly collinear with whether there was a family business. F-tests showed the three measures of ability, or any combination of two, to be jointly significant (minimum F=11.72, d.f.= 2 and 1180, $p<0.01$ for two variables, F=8.54, d.f.= 3 and 1179, $p<0.01$ for three variables).

Adding marital status, age, interactions with age, geographical dummies, and county-level data increases R^2 to 0.36 (Column 3). F-tests showed nine interaction terms between human capital and age to be jointly significant (F=1.89, $p<0.05$ with nine and 1111 d.f.), the eight census region dummies plus the dummy for California to be jointly significant (F=2.82, $p<0.01$ with nine and 1111 d.f.), and the county-level data to be jointly significant (F=12.58, $p<0.01$ with eight and 1111 d.f.). The third model shows that income increases with human capital. In addition, two out of three measures of entrepreneurial ability are positive and significant.[10]

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insert table 2 around here

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disclosure regulations. However, the qualitative results were the same as in reported results with log(income). For our reported results we rescaled the response on each interval with its midpoint, expect the uppermost interval (+$150,000), where we arbitrarily set a representative value of $200,000 in household income. Estimations were insensitive to reasonable choices of representative values for observations in the uppermost interval.

[10] A positive correlation between q and z is to be expected for constrained entrepreneurs [see equation (7).] The result is consistent with Xu's (1998) analysis and suggestion that EJ's estimation of the wealth-ability relationship was downward biased. In Xu's estimation a positive wealth-ability correlation lead to a smaller credit constraint than that reported by EJ.

We modeled the level of capital in the first year of start-up.[11] Strictly following EJ, start-up capital is initially modeled solely as a function of entrepreneurial ability and financial wealth, where XINC35 measures the percentage of owners that had a predicted household income above $35,000.[12] We then added measures of human capital. Age and work experience were highly collinear and we preferred to use work experience as a more direct measure of human capital. We then added controls for the riskiness of the business and scale economies. Results are reported in Table 3.

Column 1 shows that start-up capital increases with greater financial wealth supporting the claim the entrepreneurs are credit constrained when starting a business. While the effect weakens as we add human capital indicators (Column 2), and other controls (Column 3), the

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[11] Data on start-up assets are reported on an interval scale. An ordinal probit model was initially used to accomodate these data. These regressions are not reported because they might violate Census disclosure regulations. However, the qualitative results were the same as in reported results. For our reported results we rescaled the response on each interval with its midpoint, expect the uppermost interval (+$250,000), where we arbitrarily set a representative value of $500,000 in firm assets. Estimations were insensitive to reasonable choices of representative values for observations in the uppermost interval.

[12] Using a non-linear term for wealth is theoretically motivated. For those that are not credit constrained there is no effect of wealth on capital while for those that are credit constrained there is a positive effect. The value of predicted household income was obtained using the third model in Table 2. The $35,000 cut-off point for XINC35 is identical to one of the interval endpoints used in the Census questionnaire. We experimented with other cut-off points as well. The next cut-off point would be at $49,999, which only 10% of the owners were above. Using this or the next lower cut-off at $24,999 produced similar results as those reported for XINC35, but with weaker effects for the dummy. Households below the $35,000 threshold may have little wealth to offer as collateral making start-up capital insensitive to variations in household income at these levels. The weaker effect of the dummy when using the cut-off point $50,000 may be due to the credit constraint being lifted for a large fraction of the start-ups at a slightly lower income level. Additional wealth would then not affect start-up capital further. The weaker effect of using the cut-off point $50,000 might also be due to adverse selection (Stiglitz and Weiss, 1981). We analyzed whether the effect of wealth could be approximated by a linear term, as in HJR (1994a). To do so we estimated the model for those businesses which only had one owner. In those cases there is no need to aggregate data on income across all owners in the business and we instead used the linear term for predicted household income as regressor. The qualitative results were similar to those reported in Table 3 and 4 but the effects of the coefficients were generally weaker. These results are not surprising given that

coefficient for XINC35 remains significant. The weakening of the coefficient for XINC35 with the inclusion of human capital reveals the endogenous nature of financial wealth to human capital. The effect is reduced by 34% when measures of human capital are included. All three measure of entrepreneurial ability increases the capital level in the start-up supporting the basic EJ theory. Two of the three coefficients for ability are strong and significant even when measures of human capital are added.[13]

Firm capital is generally increasing in human capital, supporting our model extension. However, an engineering degree has a negative effect on the capital level which was surprising. Work experience has a curvi-linear effect on start-up capital, with the highest level of capital for 10-19 years of work experience. The effects of managerial experience and number of owners are both as predicted. In addition, the magnitudes of the effects of education and work experience on start-up capital are weaker than the magnitudes of the effects of the measures of entrepreneurial ability.

Controlling for business risk and scale economies decreases the magnitude of the coefficient for predicted household income by an additional 6%, suggesting a positive correlation between credit constraints and the average size of operations in an industry and

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we expect a non-linear effect. Tables with these additional results are labeled 3.1 and 4.1 and available in Appendix 1.

[13] We regressed our three measures of entrepreneurial ability on human capital (human capital) to test whether these are correlated. The associations, in terms of pseudo-R^2, are 0.06 between human capital and experience from working in a family business, 0.04 between human capital and family business background and 0.18 between human capital and previous ownership experience. The correlations with human capital weakens somewhat the interpretability of the measures of entrepreneurial ability. But since these correlations are not very large we judged it unecessary to model this structurally. The results might describe an association through a third variable, such as wealth, that is associated both with whether family members owns a business and affording college studies. We investigated this and found that the

between credit constraints and the riskiness of the venture. The negative sign for the coefficient of the proportion of plants in the 2-digit industry with fewer than 20 employees was expected. The positive sign for the proportion with fewer than 50 employees is a bit surprising. It suggests a very low threshold for scale economies. The positive and significant effect of ASSET82H indicates that industries with larger scale of operations demand more capital at start-up. Owners starting up businesses in such industries might be more credit constrained. We investigated this hypothesis by interacting ASSET82H with XINC35. Results are displayed in Column 4. First, the effect of XINC35 on start-up capital for those starting in industries where median capital scale is less than $7,500 is now less than for the average start-up. Second, the total effect of XINC35 on start-up capital is 60% higher for those starting in industries where median capital scale is more than $7,500 confirming our hypothesis.

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insert table 3 around here

EJ predicted that owners with higher levels of entrepreneurial ability are more likely to be credit constrained. We examined this prediction by interacting XINC35 with WRKFAM, OWNER, and a combination of entrepreneurial abilities where OWNER*WRKFAM=1. Only 7% of the owners had both attributes, representing, potentially, very able entrepreneurs. For brevity, the full regression model is suppressed. In Table 4, Panel 1, we compute total effects of

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association between ability and human capital do not seem highly determined by a common cause such as

XINC35 under the various conditions of entrepreneurial abilities. Columns (1) and (2) show the necessary coefficient values. In Column (3) we report the marginal effect of XINC35 on the percentage change in total firm capital at start-up for a marginal change in entrepreneurial abilities. The sign of the interaction terms are as expected but except for the three-way interaction the magnitudes of the interaction terms are small. And the effect of the three-way interaction, while large, may be driven by the small number of observations in this cell.

In Section 2 we found that by relaxing an assumption in the EJ model the effect on the credit constraint of human capital depends on the relative productivity of human capital in wage work versus self-employment. If productivity is higher in wage work than in self-employment, and if capital productivity is modest the credit constraint should diminish with an increase in human capital.

To examine the net effect of human capital on the credit constraint we interacted XINC35 with measures of education and work experience. The results are displayed in Table 4, Panel 2. Nine out of nine interactions are negative indicating that human capital is likely to reduce the credit constraint. All levels of education above high-school drop-out (the intercept) reduces the credit constraint significantly. Having a college business degree or a college science or engineering degree reduces the credit constraint further although the effects are not significant. In addition, greater work experience marginally reduces the credit constraint. However, the

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wealth.

relaxing effect of managerial experience on the credit constraint through increasing financial wealth, while reasonably strong, is completely washed out by increased capital demands.[14]

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5. SUMMARY AND DISCUSSION

We extended a model developed by Evans and Jovanovic (EJ), to explain when a start-up is credit constrained. Greater human capital increase the optimal capital level in the start-up thus increasing the credit constraint for a fixed level of wealth while greater human capital also diminishes the credit-constraint because it increases financial wealth, thus pointing to the endogenous nature of potential liquidity constraints.

In the empirical analysis we found that entrepreneurs with greater levels of human capital have both greater levels of capital when starting a business and greater financial wealth. While a large fraction of the relationship between owners' financial wealth and their business capital at start-up (about 40%) is jointly determined by human capital, we found a remaining significant positive correlation between owner wealth and firm capital. Consistent with Xu (1998), this result suggests that start-ups, on average, are financially constrained even after controlling for the co-determination of the relationship between owner wealth and firm capital by human

[14] We supplemented this analysis by analyzing only the sample of firms where more than 50% of the owners had more than $35,000 in predicted household income. The results were similar to those reported in Table 4 and to save space are not reported.

capital. The result is, however, in contrast with that of Cressy (1996) who found that there was no remaining effect of wealth on business survival once controlling for human capital.[15] In addition, we found that those who start businesses in industries with larger scale of operations are more dependent on personal financial wealth providing evidence that financial constraints become more binding as demands for capital increases.

We examined closely the effect of human capital on the extent of credit constraints and found that those with higher human capital are generally less dependent on financial wealth when starting a new business. Paradoxically, then, those that are most likely to switch into self-employment because of their greater productivity in that sector are also those most likely to be credit constrained. Conversely, those with high human capital productivity in wage work are likely to remain in wage work, but had they switched they would have been less likely to be credit constrained.

The policy implications of these results, if they hold true across samples, are interesting. First, results confirm the widely held belief that governments can increase capital allocation efficiency in the capital market(s) for start-up debt by offering relaxations of binding financial constraints. Second, 60% of observed financial constraints are in fact determined by human capital, indicating that one government strategy to increase efficiency in this market would include promoting educational attainments. Third, such a policy would likely, and paradoxically, reduce the incidence of self-employment.[16]

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[15] The difference may be due to different samples. Cressy used data on a sample of firms with business accounts in the National Westminster bank in the U.K.

[16] See Appendix 2.

REFERENCES

Bates, T., (1990): "Entrepreneur Human capital Inputs and Small Business Longevity", *Review of Economics and Statistics*, 1990, pp. 551-59.

Bernhardt, I., (1994): "Comparative Advantage in Self-Employment and Paid Work", *Canadian Journal of Economics*, 1994, pp. 273-89.

Blanchflower, D. G. and A. J. Oswald, (1990): "What Makes a Young Entrepreneur?" N. B. E. R. Working Paper No. 3252, National Bureau of Economic Research, 1990.

Cressy, R., (1996): "Are Business Startups Debt-Rationed?", *The Economic Journal*, 1996, pp. 1253-70.

Evans, D. S. and B. Jovanovic, (1989): "An Estimated Model of Entrepreneurial Choice Under Liquidity Constraints" *Journal of Political Economy*, 1989, pp. 808-27.

---------- and L. S. Leighton, (1989): "Some Empirical Aspects of Entrepreneurship", *American Economic Review*, 1989, pp. 519-35.

Grown, C. and T. Bates, (1991): "Commercial Bank Lending Practices and the Development of Black-owned Construction Companies", CES Working Paper 91-9, Washington D. C.: Center for Economics Studies, 1991.

Holt, D., Smith T. M. F. and P. D. Winter (1980): “Regression analysis of data from complex surveys”, *Journal of the Royal Statistical Society*, Vol 143 (series A).

Holtz-Eakin, D., D. Joulfaian and H. S. Rosen, (1994a) "Sticking It Out: Entrepreneurial Survival and Liquidity Constraints", *Journal of Political Economy*, 1994, pp. 53-75.

---------- (1994b), "Entrepreneurial Decisions and Liquidity Constraints", *RAND Journal of Economics*, 1994, pp. 334-47.

Jaffee, D. and T. Russel (1976): "Imperfect Information, Uncertainty, and Credit Rationing" *Quarterly Journal of Economics*, Vol. 90, 651-66.

Nucci, Alfred, "The Characteristics of Business Owners Database," Center for Economic Studies, U. S. Bureau of the Census, Discussion Paper CES 92-7

Picot, Garnett and Richard Dupuy (1996): "Job Creation by Company Size Class: Concentration and Persistence of Job Gains and Losses in Canadian Companies," working paper no. 93, Statistics Canada.

Price Waterhouse LLP, (1996): "National Survey of Small Business Finance: Methodology Report." Available from the Federal Reserve Board's web-site: http://www.bog.frb.fed.us/pubs/oss/.

Schuetze Herb J. (1998): "Taxes, Economic Conditions And Recent Trends in Male Self-Employment: A Canada-U.S. Comparison," working paper, McMaster University.

Stiglitz, Joseph E. and Andrew Weiss (1981): "Credit Rationing in Markets with Imperfect Information," *American Economic Review*, Vol. 71, 393-410.

U. S. Bureau of the Census, *Characteristics of Business Owners*, 1987 Economic Censuses CBO87-1, Washington, D.C. 1991.

Wolken, John D. (1998): "'New' Data Sources for Research on Small Business Finance," *Journal of Banking and Finance*, Vol. 22, pp, 1067-76.

Xu, Bin (1998): "A reestimation of the Evans-Jovanovic Entrepreneurial Choice Model," *Economic Letters*, Vol. 58, pp. 91-95.

APPENDIX 2

THE EFFECT OF HUMAN CAPITAL ON SELECTION INTO ENTREPRENEURSHIP.

The entrepreneur will choose to start the business if

$$max[y+r(z-k)] \quad w+rz. \tag{9}$$

Canceling the term rz from both sides and substituting the optimal k results in the following selection conditions: (A) The entrepreneurs is not credit constrained and

$$(\theta x^{\delta})^{1/(1-\alpha)}(\frac{\alpha}{r})^{\alpha/(1-\alpha)} - r(\frac{\alpha}{r})^{1/(1-\alpha)}(\theta x^{\delta})^{1/(1-\alpha)} \geq m x^{\gamma}, \tag{10}$$

or (B) the entrepreneur is credit constrained and

$$\theta x^{\delta}(\lambda c^{*} m x^{\gamma})^{\alpha} - r(\lambda c^{*} m x^{\gamma}) > m x^{\gamma}. \tag{11}$$

These selection conditions can be shown to be equivalent to the following: (A'),

$$\frac{r}{\alpha}(\frac{\alpha}{r}^{\alpha} - r)^{\alpha-1} m^{1-\alpha} x^{(1-\alpha)\gamma-\delta} \leq \theta \leq \frac{r}{\alpha}(\lambda c^{*} m)^{1-\alpha} x^{(1-\alpha)\gamma-\delta}, \tag{10'}$$

or (B'),

$$\theta \geq \max[\frac{r}{\alpha}(\lambda c^{*} m)^{1-\alpha} x^{(1-\alpha)\gamma-\delta}, m^{1-\alpha}(\lambda c^{*})^{-\alpha} x^{(1-\alpha)\gamma-\delta} + r(\lambda c^{*} m)^{1-\alpha} x^{(1-\alpha)\gamma-\delta}]. \tag{11'}$$

If θ satisfies either constraint the individual chooses self-employment. Note that compared to EJ the term z is now eliminated from the selection equations because it is endogenous to x. However, the liquidity constraint λ still remains. In this case one might term entrepreneurs above θ_{max} as human capital constrained (e.g., Cressy, 1996).

The effect of x on θ_{min}, the critical level for switching to self-employment, is $(1-\alpha)\gamma-\delta$ for both the unconstrained and the constrained entrepreneur. The decision to switch to self-employment therefore also depends on the relative productivity of human capital in wage

work versus self-employment. Contrary to EJ we find that the decision to switch is not necessarily a negative function of human capital. As human capital increases the attractiveness of wage work increases (as in EJ). However, because human capital also increases earnings in self-employment human capital has an ambiguous effect on the decision to switch into self-employment.

NON-RESPONSE ADJUSTMENTS

Like most surveys, the CBO suffers from two types of non-response bias: unit and item non-response. Unit non-response is when an owner does not return a questionnaire. The unit response rate among all white males in the 1987 CBO is about 74% (Nucci 1992, Table 1.) Other surveys of small business finance, such as the National Survey of Small Business Finance (NSSBF), experience even lower response rates. The 1993 NSSBF experienced a 59% unit non-response rate (Price Waterhouse LLP 1996).The, for Census surveys, relatively low response rate is in part attributable to a lag of about three years between year of business tax filing and receipt of a CBO questionnaire. Item non-response is when an owner decides not to answer a particular question although eligible for response. We first discuss how we dealt with unit non-response.

The survey contains weights that adjusts for unit non-response. That is, researchers at the Census determined the incidence of nonresponse by firm size, location and industry. The inverse of these response frequencies by stratum are used as weights throughout the analysis and tabulations. This method is supported by for example Holt et al. (1980). The weights do affect results considerably because there is a clear tendency for owners of smaller firms not to respond.

Item non-response varies by survey item. Table A in Appendix 4 reproduce data from Table 2 in Nucci (1992) on the per cent response per selected questionnaire items. (These items were used to construct variables as described in Table 1.) The table illustrates that item

response is above 93% for all variables except for college concentration where item response is only 73%. The reason is a questionnaire design error where respondents to the preceding question regarding highest level of education were not asked to skip the college concentration question if they did not attend college. After classifying as not eligible for response those owners that reported their highest level of education to be below college attendance the item response on college concentration increases to 97.5%. In the third column we report item response percentages for the selected sample of 778 firms representing 994 owners showing an average item response of 98%. We imputed values for the remaining item non-responses. The imputation method depended on the questionnaire item. See Table B, Appendix 4 for a tabulation of decisions regarding imputations.

Table 1. Descriptive Statistics

Label	Variable	mean	Std Dev	min	max
XINC35	% of owners with predicted household income >$34,999	0.286	0.483	0	1
FAMBUS	% of owners with family business background	0.511	0.532	0	1
WRKFAM	% of owners who have worked in a business owned by family members	0.218	0.441	0	1
OWNER	% of owners which have owned a prior business	0.199	0.421	0	1
EDU3	% of owners which are high school graduates	0.316	0.496	0	1
EDU4	% of owners which are college drop-outs	0.263	0.471	0	1
EDU5	% of owners which are college graduates	0.235	0.449	0	1
EDU6	% of owners with graduate (Ph.D. or Master's) studies	0.070	0.267	0	1
WORKEXP3	% of owners with 2-5 years of work experience	0.142	0.374	0	1
WORKEXP4	% of owners with 6-9 years of work experience	0.148	0.381	0	1
WORKEXP5	% of owners with 10-19 years of work experience	0.255	0.465	0	1
WORKEXP6	% of owners with 20 years or more of work experience	0.226	0.442	0	1
BUSINESS	% of owners with a college business degree	0.222	0.445	0	1
SCIENG	% of owners with a science or engineering college degree	0.103	0.326	0	1
MANAGER	% of owners with managerial or executive work experience	0.172	0.398	0	1
SINGLE	% of owners that have not been married	0.125	0.352	0	1
RESPNO	number of owners in the firm	1.089	0.457	1	10
DENOVO	=1 if new business; else 0	0.810	0.422	0	1
ASSET82H	=1 if industry median firm assets > $7,500; else 0	0.206	0.4.35	0	1
SCALE20	% of plants in SIC2 with 1-19 employees	0.887	0.084	0.46	0.97
SCALE50	% of plants in SIC2 with 1-49 employees	0.958	0.048	0.64	0.99
N=873					

Table 2. Household Income.

Variable	log(income)	log(income)	log(income)
Intercept	9.658***	9.596***	7.890***
	(0.081)	(0.083)	(0.608)
EDU3	0.253**	0.243**	0.206*
	(0.082)	(0.082)	(0.081)
EDU4	0.181*	0.185*	0.209*
	(0.090)	(0.089)	(0.099)
EDU5	0.494***	0.495***	0.578***
	(0.092)	(0.092)	(0.109)
EDU6	0.889***	0.861***	0.777***
	(0.112)	(0.112)	(0.155)
BUSINESS	0.169*	0.142*	0.127
	(0.068)	(0.067)	(0.084)
SCIENG	0.077	0.080	0.213
	(0.084)	(0.083)	(0.115)
WORKEXP3	-0.086	-0.085	0.113
	(0.082)	(0.082)	(0.078)
WORKEXP4	0.270***	0.293***	0.304***
	(0.080)	(0.080)	(0.080)
WORKEXP5	0.262***	0.250***	0.243**
	(0.069)	(0.069)	(0.088)
WORKEXP6	0.247***	0.200**	0.109
	(0.073)	(0.073)	(0.129)
MANAGER	0.139*	0.053	-0.026
	(0.065)	(0.067)	(0.097)
35-44 YEARS OLD			0.154
			(0.074)
45-54 YEARS OLD			0.085
			(0.121)
+55 YEARS OLD			0.496*
			(0.197)
FAMBUS		0.081	0.175*
		(0.055)	(0.075)
WRKFAM		-0.019	-0.038
		(0.067)	(0.087)
OWNER		0.287***	0.237*
		(0.062)	(0.099)
SINGLE			-0.893***
			(0.073)
9 INTERACTIONS WITH AGE			F=1.89*
8 CENSUS REGION DUMMIES + CALIF.			F=2.82**
7 COUNTY-LEVEL CENSUS POP. VARS. + MET			F=12.58***
R2	0.13	0.15	0.36
n	1194	1194	1156

*** p < 0.05, ** p <0.01, *** p <0.001**

Table 3. Start-Up Capital.

Variable	log(capital)	log(capital)	log(capital)	log(capital)
	(1)	**(2)**	**(3)**	**(4)**
Intercept	8.907***	8.361***	6.847***	6.841***
	(0.059)	(0.150)	(1.161)	(1.161)
XINC35	0.457***	0.302***	0.272**	0.238*
	(0.089)	(0.102)	(0.096)	(0.107)
FAMBUS	0.019	0.053	0.020	0.010
	(0.090)	(0.089)	(0.084)	(0.085)
WRKFAM	0.205	0.221*	0.268**	0.276**
	(0.109)	(0.109)	(0.102)	(0.103)
OWNER	0.526***	0.397***	0.382***	0.377***
	(0.103)	(0.109)	(0.103)	(0.103)
EDU3		0.119	0.109	0.108
		(0.131)	(0.123)	(0.123)
EDU4		-0.004	0.092	0.085
		(0.143)	(0.134)	(0.135)
EDU5		0.097	0.219	0.219
		(0.153)	(0.145)	(0.145)
EDU6		0.374	0.348	0.347
		(0.202)	(0.191)	(0.191)
BUSINESS		0.073	0.025	0.037
		(0.110)	(0.104)	(0.106)
SCIENG		-0.124	-0.188	-0.189
		(0.137)	(0.129)	(0.129)
WORKEXP5		0.160	0.184*	0.183*
		(0.092)	(0.087)	(0.087)
WORKEXP6		0.037	0.085	0.090
		(0.102)	(0.096)	(0.096)
MANAGER		0.310**	0.221*	0.218*
		(0.114)	(0.107)	(0.107)
RESPNO		0.371***	0.269**	0.264**
		(0.089)	(0.086)	(0.086)
DENOVO			-0.760***	-0.758***
			(0.092)	(0.092)
SCALE20			-3.571**	-3.691**
			(1.374)	(1.384)
SCALE50			5.544*	5.678*
			(2.316)	(2.232)
ASSET82H			0.416***	0.365**
			(0.098)	(0.120)
XINC35*ASSET82H				0.144
				(0.195)
R2	0.09	0.13	0.24	0.24
n	872	872	872	872

*** p < 0.05**

**** p <0.01**

***** p <0.001**

Table 4. Effects of XINC35 on Firm Capital.

Panel 1	Coefficient Values		Marginal percentage effect of XINC35 on firm capital
	First-order Effect	Interaction Term	Ent. Ability = 1, XINC35=1
	(1)	(2)	(3)
WRKFAM	0.264	0.119	47%
	(0.128)	(0.236)	
OWNER	0.479	0.066	72%
	(0.154)	(0.250)	
(OWNER*WRKFAM=1)	-0.754	0.870	184%
	(0.301)	(0.442)	
Panel 2			Marginal percentage effect of XINC35 on firm capital HC = 1, XINC35 = 1
EDU3	0.196	-1.839	-81%
	(0.126)	(0.582)	
EDU4	0.218	-1.632	-76%
	(0.143)	(0.584)	
EDU5	0.118	-1.014	-59%
	(0.158)	(0.588)	
EDU6	0.685	-1.610	-60%
	(0.345)	(0.659)	
BUSINESS	0.040	-0.264	-20%
	(0.133)	(0.226)	
SCIENG	-0.174	-0.292	-37%
	(0.172)	(0.273)	
WORKEXP5	0.140	-0.052	9%
	(0.105)	(0.193)	
WORKEXP6	0.203	-0.569	-31%
	(0.109)	(0.247)	
MANAGE	0.408	-0.356	5%
	(0.137)	(0.229)	

APPENDIX 1

ADDITIONAL REGRESSIONS REFERRED TO IN FOOTNOTE 12.

Table 3.1 Start-Up Capital.

Variable	log(capital)	log(capital)	log(capital)	log(capital)
	(1)	**(2)**	**(3)**	**(4)**
Intercept	8.591***	8.583***	6.997***	7.059***
	(0.100)	(0.141)	(1.323)	(1.329)
Predicted hhld income*10^-5	0.157***	0.106**	0.090*	0.082*
	(0.031)	(0.038)	(0.036)	(0.039)
FAMBUS	-0.040	-0.018	-0.033	-0.040
	(0.097)	(0.098)	(0.092)	(0.094)
WRKFAM	0.221	0.239*	0.300**	0.305**
	(0.117)	(0.118)	(0.113)	(0.113)
OWNER	0.471***	0.394**	0.404***	0.404***
	(0.113)	(0.122)	(0.115)	(0.115)
EDU3		0.096	0.071	0.073
		(0.144)	(0.136)	(0.137)
EDU4		-0.056	0.032	0.027
		(0.156)	(0.148)	(0.148)
EDU5		0.047	0.159	0.157
		(0.170)	(0.162)	(0.162)
EDU6		0.369	0.306	0.301
		(0.237)	(0.224)	(0.225)
BUSINESS		0.061	0.016	0.022
		(0.119)	(0.114)	(0.114)
SCIENG		0.004	-0.113	-0.116
		(0.155)	(0.148)	(0.148)
WORKEXP5		0.126	0.171	0.171
		(0.101)	(0.096)	(0.096)
WORKEXP6		0.067	0.114	0.117
		(0.112)	(0.107)	(0.108)
MANAGER		0.275*	0.188	0.186
		(0.126)	(0.119)	(0.119)
RESPNO		NA	NA	NA
DENOVO			-0.734***	-0.735***
			(0.103)	(0.103)
SCALE20			-3.401*	-3.459*
			(1.568)	(1.573)
SCALE50			5.366*	5.384*
			(2.632)	(2.633)
ASSET82H			0.418***	0.309
			(0.110)	(0.234)
XINC35*ASSET82H				0.034
				(0.065)
R2	0.09	0.11	0.21	0.21
n	703	703	703	703

*** p < 0.05**

**** p <0.01**

***** p <0.001**

APPENDIX 1

ADDITIONAL REGRESSIONS REFERRED TO IN FOOTNOTE 12.

Table 4. 1 Effects of Predicted Household Income on Firm Capital.

Panel 1	Coefficient Values	
	First-order Effect (1)	Interaction Term (2)
WRKFAM	-0.057	0.140
	(0.269)	(0.084)
OWNER	0.640	-0.047
	(0.319)	(0.085)
(OWNER*WRKFAM=1)	-0.498	0.061
	(0.596)	(0.154)
Panel 2		
EDU3	0.766	-0.331
	(0.412)	(0.194)
EDU4	0.881	-0.363
	(0.419)	(0.191)
EDU5	0.196	-0.093
	(0.427)	(0.199)
EDU6	0.848	-0.216
	(0.679)	(0.208)
BUSINESS	0.222	-0.080
	(0.275)	(0.079)
SCIENG	-0.152	-0.033
	(0.360)	(0.099)
WORKEXP5	-0.143	0.086
	(0.232)	(0.069)
WORKEXP6	0.626	-0.183
	(0.270)	(0.086)
MANAGE	0.351	-0.023
	(0.289)	(0.080)